GRAND LAKE, OKLAHOMA

REAL ESTATE ADEQUACY STUDY

US Army Corps of Engineers ®
Tulsa District

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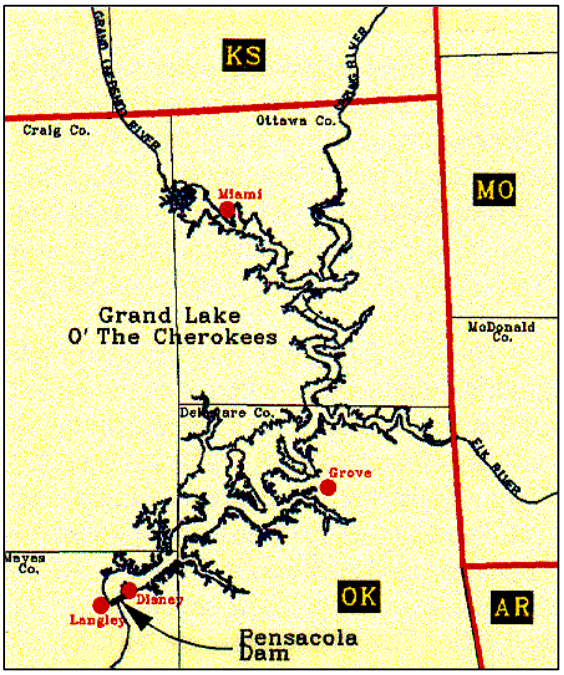
REAL ESTATE ADEQUACY STUDY

INTRODUCTION

Grand Lake O' the Cherokees (also called Grand Lake and Pensacola Lake) is located on the Grand (Neosho) River in northeastern Oklahoma. The lake is impounded by Pensacola Dam which is located between the towns of Disney and Langley, Oklahoma. The reservoir extends northward and eastward through Mayes, Craig, Delaware, and Ottawa counties in northeastern Oklahoma, and McDonald County in southwestern Missouri. Grand Lake is operated by the Grand River Dam Authority (GRDA) for recreation and hydropower and by the United States through the U.S. Army Corps of Engineers for flood control. Section 560 of the 1996 Water Resources Development Act authorized the study contained in this report. That legislation was in response to questions about the adequacy of existing flowage easements for flood control operations.



BACKGROUND

Grand Lake was designed and constructed by the GRDA for flood control and hydropower. When Grand Lake was completed in 1940, it was the first hydroelectric facility in Oklahoma. Although constructed over 57 years ago, it is promoted as the world's longest multiple arch dam - spanning about 1 mile. The structure has 51 arches and 21 spillway gates, and the dam is about 150 feet tall at the riverbed. The reservoir covers over 72 square miles, is over 65 miles long, and has a shoreline of over 1,340 miles. Grand Lake is considered a retirement center for the region, and recreation, business, and retirement interest around the lake continues to increase.

The GRDA was created by the Fifteenth Oklahoma Legislature in 1935 as a conservation and reclamation district. The State agency is self-supporting and is funded primarily by revenues from the sale of electricity.

The U.S. Army Corps of Engineers, Tulsa District was formed July 1, 1939. The Flood Control Act of 1941, Public Law 77-228, dated August 18, 1941, included Grand Lake in the comprehensive flood control plan for the Arkansas River. The effect of the Public Law was to

authorize the Corps of Engineers to manage flood control. Operation of flood control storage became the responsibility of the Corps of Engineers through the provisions of Section 7 of the Flood Control Act of 1944.

The Federal Power Commission issued a license to the GRDA in 1939 to construct, operate, and maintain Grand Lake. The license provided for storage of floodwaters between elevations 745 and 755 (as directed by the Secretary of War). The license further provided that the GRDA was not required to impound any water above elevation 750 until the United States had acquired easements above that elevation. The GRDA acquired lands to a flat pool elevation of 750.

The President assumed control of this and other projects on November 21, 1941, for national defense purposes, under Section 16 of the Federal Power Act. Executive Order 8944 authorized and directed the Federal Works Administrator to take possession of, manage, and operate the project. Through the Federal Works Administration, the Federal Power Commission approved the storage of waters for flood control purposes between elevations 745 and 755 mean sea level, and authorized the acquisition of additional lands necessary for such operation. The Federal Power Commission operated the project until August 1946.

The U.S. Army Corps of Engineers (Corps of Engineers) had begun preparations to acquire the additional easements above elevation 750 when the President, on December 10, 1942, directed the Federal Works Administrator, under authority of Title 2 of the National Industrial Recovery Act, to acquire additional acreage for flood control. During acquisition by the Federal Works Administration and before completion of acquisition, all responsibilities were transferred to the Secretary of the Interior by Executive Order 9373. The Secretary of the Interior designated the Southwestern Power Administration (SWPA) as the agent to perform the remaining acquisition. The acquisition of 11,700 acres of flowage easements was completed in June 1947. These easements are between elevations 750 and 757 at the dam and elevations 750 and 760 in the upper reaches of the reservoir.

In 1964, by Public Law 79-572, the Secretary of the Interior was directed to adjust and settle accounts between the GRDA and the United States and to return possession and control of the property to the GRDA. The exception was that the United States would have easements above elevation 750 by grant from the GRDA. The easements retained or received by grant by the United States were managed and controlled by the SWPA for the Department of Interior, but the SWPA did not have authority or funds to perform flood control functions.

During Corps of Engineers preparations to acquire easements in the 1940's, an analysis was performed that indicated easements should be acquired as high as elevation 769. The Corps of Engineers and the SWPA disagreed concerning the extent of the backwater effects. The Corps of Engineers later submitted an April 1948 Preliminary Planning Report indicating that, in addition to the 11,700 acres of easements already acquired, an additional 11,750 acres of easements should be acquired for operation of the project for flood control.

From 1946 through 1950, negotiations were conducted between the Department of the Army and the Department of the Interior to effect transfer of the existing easements of 11,700

acres. Action on the Corps of Engineers Preliminary Planning Report was deferred until studies of the 1951 flood were completed. (Note: The 1951 flood is still the largest recorded event in the Grand Lake reach of the Grand [Neosho] River.) The transfer of lands and interests to the Corps of Engineers was completed October 31, 1959. In a June 1, 1960, letter to the Southwestern Division Engineer, Dallas, Texas, Thomas D. Quaid, Acting Tulsa District Engineer indicated that operation of Pensacola Reservoir since the 1951 flood had been carried out without complaint from people in the affected area. Because the operation proved satisfactory, acquisition of additional lands was not recommended at that time. By letter dated September 2, 1960, the project for acquisition of additional lands for the Pensacola Reservoir was reclassified from active to inactive status by Robert M. Tarbox, Assistant Director of Civil Works for the Southwestern Division, Corps of Engineers.

Heavy rains began to fall in September 1986 throughout much of the Midwest. At Miami, Oklahoma, which is located at the upper end of the Grand (Neosho) River arm of Grand Lake, the total rainfall for September 1986 was 14.95 inches. A total of 11.29 inches had fallen in only 5 days. Similarly, large rainfall amounts were recorded in the river basin upstream of Miami (and Grand Lake). In Miami, flooding began on September 30 with a flash flood on Tar Creek (a small tributary to the Grand River) and continued to worsen through October 6 as Grand (Neosho) River flows peaked. At its highest, the Grand River flood had a recorded discharge of 122,700 cubic feet per second. This flow was slightly less than the estimated peak flow of a flood that would, on average, occur once every 50 years at Miami. The 50-year flood, calculated at the time, would have a peak flow of 150,000 cubic feet per second. By September 30, the lake had filled to elevation 748.40 and was, at that time, rising at a rate of 1 foot every hour. The water level in Miami was then at elevation 759.83 at the Highway 66 bridge west of town. On October 6, Grand River floodwaters crept into Miami residential areas. Residents of over 380 homes were evacuated, and over 40 businesses were flooded. The Grand Lake water level was at elevation 754.92. This event came to be known as “The 1986 Flood”.

Following the 1986 Flood, public concern and frustration about Grand (Neosho) River flooding and the Grand Lake flood easement issue were elevated. The intensity of public concern grew with each following flood event in the Miami area. One outlet for these issues occurred when a public meeting was held September 22, 1987, at the Miami Civic Center. The meeting was attended by hundreds of flood victims, including farmers, urban residents, and business owners. Also in attendance were business and recreational interests and representatives of local, State, and Federal agencies that were impacted by or involved in the issues.

Also following the 1986 Flood and as a result of public concern, Congress directed the Corps of Engineers to conduct a reconnaissance study to identify solutions to the flooding problems of Miami and the surrounding area. The reconnaissance study, conducted from March 1988 through March 1989, found a number of levee alternatives to be economically justified. The Corps of Engineers negotiated the scope of the potential next phase of effort, a cost shared feasibility study, with a City-appointed Flood Committee. The proposed feasibility study was brought before the Miami City Commission. The decision of the City Commission was not to initiate the feasibility study due to lack of funds, both for the feasibility study and potentially for construction of identified flood control measures.

During research for the reconnaissance study, information about land transfers and findings of the Preliminary Planning Report were discovered and brought to the attention of the study sponsor, the City of Miami. Because the level of detail and time required to conduct a real estate study of all of Grand Lake was greatly beyond the scope and time and financial constraints of the reconnaissance study, the Miami Flood Committee and the Corps of Engineers agreed to complete the reconnaissance study of local flood problems at Miami and to request a separate additional study that would evaluate the real estate adequacy issue. It was proposed that this additional study would also identify and evaluate alternatives to flood easement acquisition, such as lowering the top of the flood control pool. (Note: That study request was under evaluation by Corps of Engineers higher headquarters when Congress authorized a similar study in Section 560 of the 1996 Water Resources Development Act.)

The common interests and beliefs of flood victims and lakeside landowners resulted in the formation of two advocacy groups. The first to organize was the Kansas/Oklahoma Flood Control Alliance (KOFCA). The second group was the Grand/Neosho River Committee (GNRC) which was formed through the efforts of five Congressional leaders; Senator Bob Dole and Senator Nancy Kassebaum of Kansas, Representative Mike Synar of Oklahoma, and Senator David Boren and Senator Don Nickles of Oklahoma. The purpose of the Committee is stated in their February 15, 1996, report, **Final Report and Recommendations:** *"To gain an additional degree of public participation in the management of the Grand/Neosho River Basin. The purpose of the Committee is to provide a forum to make in-branch recommendations concerning issues about the Grand/Neosho River Basin to the GRDA and the Corps of Engineers, who are authorized and responsible by public law to operate the project in accordance with authorizing legislation."* The GNRC 1996 report recommended a review of the adequacy of existing flowage easements at Grand Lake. The most recent GNRC meeting was held in February 1996.

Local citizens, including several GNRC members, took legal action against the GRDA in October 1994, and the GRDA subsequently named the Corps and the Federal Energy Regulatory Commission as third party defendants. Prior to the legal action, the Corps of Engineers, the GRDA, and the Congressional delegation were actively involved in the GNRC. Initially following the legal action, the GRDA, the Corps of Engineers, and the Congressional delegation suspended or curtailed meeting participation, but all subsequently resumed participation. The Corps of Engineers was dismissed from two cases in the U.S. Northern District Court of Oklahoma. The GRDA appealed the dismissal of the Corps of Engineers to the U.S. Court of Appeals, Tenth Circuit. Oral arguments were held December 17, 1997. On May 28, 1998, the U.S. Court of Appeals, Tenth Circuit, affirmed the District Court's dismissal of the third party complaint against the Corps of Engineers. The GRDA petition for a rehearing was denied on July 28, 1998. The Corps of Engineers has not been notified whether GRDA will seek a review of the Tenth Circuit decision by requesting a writ of certiorari from the U.S. Supreme Court.

Descriptions of the Grand (Neosho) River Basin and Grand Lake and its major tributaries can be found in the Hydraulic Analysis and Hydrologic Analyses (Appendices A and B, respectively.)

A brief chronology of events related to real estate, acquisition, and flood issues is presented in Appendix C.

STUDY AUTHORITY

This Real Estate Adequacy Study was authorized by the Water Resources Development Act of 1996, Section 560: Grand Lake, Oklahoma. The authorization may be referred to as **Section 560** within this report. The citation is shown below.

Section 560: Grand Lake, Oklahoma

Citation:

(a) STUDY - Not later than 1 year after the date of the enactment of this Act, the Secretary shall carry out and complete a study of flooding in the Grand/Neosho Basin and tributaries in the vicinity of Pensacola Dam in northeastern Oklahoma to determine the scope of backwater effects of operation of the dam and to identify any lands that the Secretary [of the Army, through the Corps of Engineers] *determines have been adversely impacted by such operation or should have been originally purchased as flowage easements for the project.*

(b) ACQUISITION OF REAL PROPERTY - Upon completion of the study and subject to advance appropriations, the Secretary may acquire from willing sellers such real property interests in any lands identified in the study as the Secretary determines are necessary to reduce adverse impacts identified in the study conducted under subsection (a).

(c) IMPLEMENTATION REPORTS - The Secretary shall transmit to Congress reports on the operation of Pensacola Dam, including data on and a description of releases in anticipation of flooding (referred to as "precautionary releases"), and the implementation of this section. The first of such reports shall be transmitted not later than 2 years after the date of the enactment of this Act.

(d) AUTHORIZATION OF APPROPRIATIONS -

(1) IN GENERAL - There is authorized to be appropriated to carry out this section $25,000,000.

(2) MAXIMUM FUNDING FOR THE STUDY - Of amounts appropriated to carry out this section, not to exceed $1,500,000 shall be available for carrying out the study under subsection (a).

STUDY PURPOSE AND SCOPE

The study contained in this report is a partial response to part "(a)" of Section 560 and is referred to as the **Real Estate Adequacy Study** throughout the rest of this report. The Real Estate Adequacy Study is, therefore, an interim response to Section 560. The study completion period of "*1 year after the date of the enactment of this Act"* could not be accomplished because authorized study funds were reduced to $990,000 by the Conference Report on House Report 3816, Energy and Water Development Appropriations Act, 1997, which left one-third of the study unfunded. Completion funds were provided in December 1997, and the completion date was established as March 1998.

In a typical Corps of Engineers study, a six-step planning process would be followed. These six steps are as proscribed in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (also known as **Principles and Guidelines or P&G**). However, this Real Estate Adequacy Study is a technical evaluation that only loosely followed the first two of the six P&G steps shown below. The study authorization

specified the problem – step 1, and the Real Estate Adequacy Study accomplished problem analysis based on direction of Section 560 – step 2.

1) *Specification of the water and related land resource problems and opportunities (relevant to the planning setting) associated with the Federal objective and specific State and local concerns.*

2) *Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to identified problems and opportunities.*

3) *Formulation of alternative plans.*

4) *Evaluation of the effects of alternative plans.*

5) *Comparison of alternative plans.*

6) *Selection of a recommended plan based upon the comparison of alternative plans.*

The Real Estate Adequacy Study responds to the direction of Section 560, *"…the Secretary* [of the Army, through the Corps of Engineers] *shall carry out and complete a study of flooding…to determine the scope of backwater effects …and to identify any lands that …have been adversely impacted …or should have been originally purchased as flowage easements for the project* [at Grand Lake, Oklahoma]*"* by estimating the flowage easements that would be acquired using current Corps of Engineers guidance, regulations, methodologies, and technology (collectively termed **current criteria**) given Grand Lake pool elevations, flood control purpose, and operational criteria as of the date of this report. When these **current criteria** are utilized to evaluate the acquisition requirements of a potential reservoir project, it is an "Administrative approach" to acquisition guided by current criteria developed in the Executive Branch of the Government (which includes the Corps of Engineers). The purpose of the criteria is to avoid possible adverse impacts throughout the operational life of a project. The process is used to identify potential real estate impacts during design of a project and then to acquire real estate interests before a project is constructed.

In responding to Section 560, Grand Lake was treated as a "potential project" and **current criteria** were used to determine the scope of backwater impacts and the limits of flowage easements that would have been recommended for acquisition using the Administrative approach to acquisition requirements of a potential reservoir project. Historic flood data were used in hydrologic and hydraulic evaluations (part of the current criteria) to estimate theoretical backwater impacts as if Grand Lake were a potential project. This "potential project" approach provides an estimate of real estate impacts throughout "future" project life. Mapping was developed to show the limits of flowage easements that would have been recommended for acquisition and the limits of existing easements at Grand Lake.

Guidance developed by the Headquarters, U.S. Army Corps of Engineers (HQUSACE) in response to Section 560 (see Appendix D) further defines the purpose and scope of the Real Estate Adequacy Study. The guidance comes in two parts. Part one, initial guidance (see Appendix D, part one), was provided as documentation of the discussion and direction provided by the HQUSACE following a video-teleconference held October 18, 1996. Part two, final guidance, was provided by the HQUSACE on November 19, 1997. For this discussion, the key point in the final guidance is framed in the statements: "*If warranted by the findings of the effort*

initiated in Fiscal Year 1997, request funding under applicable budget guidance to prepare a decision document to summarize the investigation and present a recommended plan of action. The recommended plan should be economically justified and the most cost effective alternative available." The full text of the final guidance can be seen in Appendix D, part two. The reason for the guidance is as follows. The perceived intent of Congress through Section 560 was primarily: (a) to identify lands that may be impacted beyond the limits of existing flowage easements, and (b) to provide the authority for acquisition of such identified lands. The HQUSACE guidance expresses the Administration's additional intent to: (a) evaluate the cost of acquisition, if warranted, against the cost of other alternatives formulated to reduce or eliminate the adverse impacts of backwater effects, and (b) to follow Corps of Engineers planning guidance for the recommendation of an economically justified alternative, and it must be the most cost effective alternative.

CURRENT CRITERIA COMPONENTS

The following discussions highlight three primary elements of criteria used in the evaluation of theoretical backwater impacts.

Mapping

The topographic mapping used in this study was created in digital form which greatly facilitated presentation of large geographic areas on relatively small-scale report figures. Development of the topographic maps, evaluation of the proposed acquisition guideline to existing flowage easements, and preparation of figures shown later in this report were accomplished with the use of computer-aided drafting equipment. Notes presented on the last figure relate to development of mapping in general and development of small-scale figures. Several issues discussed in those notes relate to the accuracy of the mapping. The overall accuracy and quality of the digital topography is high. Any computer-aided drafting techniques used in this study that reduced the overall accuracy of the findings were applied when the impacts were known to be negligible on study findings and only for the purpose of completing the study on time and within budget. Application of these techniques does not diminish the quality of the original digital topography or its potential usefulness in the future.

Hydrology and Hydraulics

Guidance for the hydrologic studies used in the acquisition of reservoir lands for Corps of Engineers projects is contained in *"Southwestern Division Engineering Technical Letter (ETL) 1110-2-22", Hydrologic Criteria for Acquisition of Reservoir Lands.* The guidance is a compilation and updating of hydrologic criteria pertaining to acquisition of reservoir lands and describes its applications to several types of reservoir projects most common to Southwestern Division construction. The guidance is provided in Appendix E. From the ETL, *the flood control project classification* was established as *reservoir perimeter areas which will have no urban or highly concentrated developments*. This classification defined the land acquisition flood (LAF) which is the first evaluation step. The LAF selected has an average recurrence frequency of once in 50 years. The final evaluation step results in the guide taking line (GTL)

which defines the limits of flowage easements that would have been recommended for acquisition of a potential project. The guide taking line *is "a reservoir pool elevation profile which encompasses the full pool and freeboard. This profile will be used by land acquisition personnel as a guide for the upper limit to which land should be acquired for the purpose of regulating reservoir inflows."* Although an evaluation of a hypothetical guide taking line was conducted using current criteria, a takings analysis for the purpose of establishing if a government taking of property actually has occurred was beyond the scope of this study, and no taking analysis was performed.

If at any location around the lake the guide taking line was found to have exceeded the limits of existing easements, then this study would have identified an area where the backwater impacts exceed the limits of existing flowage easements. This impacted area would be identified as lands that would have been recommended for acquisition, using current criteria.

If at any location around the lake the guide taking line was found to fall within the limits of existing easements, then the study would have identified an area where existing flowage easements would not have been recommended for acquisition, using current criteria. This situation was not examined.

Real Estate

Guidance for determining the type of acquisition is contained in the Real Estate Handbook, Engineering Regulation (ER) 405-1-12. The guidance for reservoir acquisition follows:

> *"8.0 Acquisition of lands for* [U.S. Army Corps of Engineers] *reservoir projects. Insofar as permitted by law, it is the policy of the Departments of the Interior and of the Army to acquire, as a part of reservoir project construction, adequate interest in lands necessary for the realization of optimum values for all purposes including additional land areas to assure full realization of optimum present and future outdoor recreational and fish and wildlife potentials of each reservoir.*
>
> *8.1 Lands for reservoir construction and operation. The fee title will be acquired to the following:*
>
> *(a) Lands necessary for permanent structures.*
> *(b) Lands below the maximum flowage line of the reservoir including lands below a selected freeboard where necessary to safeguard against the effects of saturation, wave action, and bank erosion and to permit induced surcharge operation.*
> *(c) Lands needed to provide for public access to the maximum flowage line as described in paragraph lb, or for operation and maintenance of the project.*
>
> *8.2 Additional lands for correlative purposes. The fee title will be acquired for the following:*
>
> *(a) Such lands as are needed to meet present and future requirements for fish and wildlife as determined pursuant to the Fish and Wildlife Coordination Act.*
> *(b) Such lands as are needed to meet present and future public requirements for outdoor recreation, as may be authorized by Congress.*
>
> *8.3 Easements. Easements in lieu of fee title may be taken only for lands that meet all of the following conditions:*
>
> *(a) Lands lying above the storage pool.*
> *(b) Lands in remote portions of the project area.*
> *(c) Lands determined to be of no substantial value for protection or enhancement of fish and wildlife resources, or for public outdoor recreation.*
> *(d) It is to the financial advantage of the Government to take easements in lieu of fee title."*

The Real Estate Handbook defines an easement as: "a property right of specified use and enjoyment falling short of fee ownership. It follows that the value of an easement is less than the

market value of fee title to the same portion of property". The Handbook further indicates, "The measure of compensation for an easement is the amount by which market value of the ownership is diminished by the imposition of the easement."

As discussed in the Introduction, existing flowage easements in the Pensacola Reservoir were acquired by the Secretary of the Interior or the Federal Works Administrator. Nine different flowage easement estates were obtained. The easements ranged from elevations 750 to 757 at the dam to elevations 750 to 760 in the upper reaches of the reservoir and totaled about 11,700 acres. The minimum estate acquired provided for the right of the United States "*to inundate, submerge and flow; and to enter upon the lands from time to time...*". The maximum flowage easement estate provided for the additional right "*to cut and clear all timber therefrom and to remove or require the removal therefrom of all obstructions, natural or artificial structures, building, fences and other improvements...*". In many cases, existing flowage easements do not prohibit structures for human habitation. Typical flowage easements developed under current criteria include similarly worded restrictions, but do prohibit structures for human habitation. Provisions within current criteria allow structures for human habitation that meets certain criteria to remain within the limits of a flowage easement.

STUDY FINDINGS

Areas were found around the lake where, using current criteria and based on current lake operations, additional flowage easements would be recommended if Grand Lake was a "new" project. The attached figures display elevations, existing flowage easements, and limits of the backwater effects as represented by a guide taking line. The GRDA owns the area below 750 feet National Geodetic Vertical Datum (NGVD), 1929. This area is depicted in dark blue on the maps. Above 750 feet, the existing flowage easements are depicted in light blue. Areas where the guide taking line exceeds the limits of existing easements are shown in yellow and cover a total of about 3,560 acres. Figure 1 is an index showing the relative locations of the other figures. Figure 2 shows selected views of a predominately rural area (north of Miami on the Grand [Neosho] River), and Figure 3 shows an urban area (southern Miami) and a resort/ retirement area (located on Monkey Island). These areas were identified early in the study process for their differences in land use and their distance from Pensacola Dam. These figures are shown in slightly more detail than Figures 4 through 17 which form a set of maps that cover all of Grand Lake.

Although identification of individual property ownership or appraisal of property and improvements was beyond the scope of this study, the number of structures estimated to be habitable structures (or businesses) in the existing flowage easements and those additional structures within the guide taking line were estimated. These estimates were developed from draft working-map enlargements of the topographic mapping included in this report. Structure outlines were used in the estimate, and no field verification was conducted. An attempt was made to identify and exclude boat docks by their location and non-habitable structures based on their typically small footprint, and to identify and include habitable structures (or businesses) based on their typically larger footprint. Therefore, the estimates may exclude small motor homes and smaller modular homes and trailers. About 1,600 structures of significant size are

within the limits of existing flowage easements. Another 1,600 structures are within the guide taking line, including about 200 structures in the vicinity of Miami. It should be noted that the number of structures does not equal the number of real estate interests that would be affected within the existing easement area or within the additional area of the backwater envelope. Multiple interests may exist for homes, cabins, condominiums, and formal and informal time-shares. Many interests exist for properties that do not have improvements.

A small sample of the real estate improvements around the lake can be seen in enlarged portions of aerial photography obtained in 1997. These images can be seen following the figures at the back of this report. Over 1,000 photographs were used in development of the topographic mapping.

HISTORIC FLOODING REVIEW

Analysis of a selected number of historic floods on the Grand River indicated that backwater impacts due to Pensacola Dam have exceeded existing flowage easements, and these areas would not have flooded during those events without the dam in place. Analysis also indicated the impacts are within the guide taking line (the guide taking line is the Administrative approach to real estate acquisition for a proposed "new" project). The analysis is discussed in the Hydraulic Analysis appendix, Appendix A. While a determination of the exact extent of the backwater effects of each event was beyond the scope of this study and was not conducted, there is clearly flooding outside the easement area which is caused by Grand Lake and Pensacola Dam. The significance of the flooding caused by the dam should be evaluated in future studies.

SUMMARY

Grand Lake was constructed in 1940 for flood control and hydropower by the GRDA, an agency of the State of Oklahoma. Grand Lake is operated by the GRDA for recreation and hydropower and by the United States through the Corps of Engineers for flood control. Real estate interests are also divided between the GRDA and the Corps of Engineers. In 1959, the Corps of Engineers received the flowage easement interests at Grand Lake.

The examinations of flooding, backwater effects, and adverse impacts, and the identification of flowage easements were conducted using the body of applicable Corps of Engineers regulations and guidance collectively termed current criteria. Those current criteria were applied in the examination of Grand Lake flowage easements as if Grand Lake were a proposed project (i.e., a new project). All the pertinent lake data used in the examinations were those defining the current configuration and operation of Grand Lake.

Theoretical backwater effects of Grand Lake were found to exceed the limits of existing flowage easements using the criterion of a 50-year land acquisition flood. If Grand Lake were a new Federal project and real estate were acquired using the guide taking rules of the Southwestern Division, which is a guide for determining flowage easements including freeboard, approximately 3,500 acres of additional easements would be considered for real estate acquisition. It was estimated that about 1,600 residences and businesses were located in the

approximately 3,500-acre area. About 200 of the 1,600 structures were located in the vicinity of Miami, Oklahoma. The locations and relative sizes of areas where backwater effects were found to exceed the limits of existing flowage easements ranged from small areas in the vicinity of Pensacola Dam and throughout the lake to larger areas along the upstream reaches of the Grand (Neosho) River. This includes areas in Miami and in the vicinity of Miami. It was also estimated that about 1,600 additional residences or businesses are located within the limits of existing easements that cover an area of about 11,700 acres.

A full determination of the exact extent of backwater impacts of Pensacola Dam was beyond the scope of this study. Moreover, backwater impacts specifically due to flood control operations on lands around the reservoir, for which real estate interests are not held, have not been evaluated. Additional analyses may be desirable to further develop the findings of this report.